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ABSTRACT

Composing is controlled by information feedback from prior behavior which serves to influence future behavior. This model posits movement toward a desired end product through a continual interchange of writing and examining and evaluating what has been written against internal standards. A study was conducted to determine the extent to which interrupting feedback (by taking away visual access to what has been written) affects the writing of experienced, good writers and inexperienced, poorer writers. Writing was reviewed on both the sentence level and in terms of overall quality. Two groups of nine students were asked to write two essays, one with standard ink and the other with invisible ink. Results indicate that when writing under conditions of interrupted feedback, the subjects produced essays which differed from those produced under normal circumstances. Feedback disruption interfered only with one level of processing: discourse production. No apparent difficulty was experienced in producing well-formed, relatively error-free sentences with feedback either present or absent. This suggests that both inexperienced and experienced writers have internalized a writing style which can be produced automatically in a timed writing situation in response to a given topic. (JK)

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Examining the Function of Visual Feedback in Text Production*

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*This paper is an extended version of a talk given at the Annual Meeting of the American Association for Applied Linguistics (4th, New York, New York, December 27-30, 1981).

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I. Introduction

In recent years it has become commonplace to talk about the recursive nature of the composing process. Using case study evidence, Perl (1979) characterized composing as a king of "retrospective structuring." On the basis of their protocol research, Flower and Hayes (1980) have suggested that composing consists of three major processes--planning, translating, and reviewing--which can occur recursively. Sommers (1978) concluded, also from case studies, that revision is a recursive process which occurs throughout composing. Thus, researchers have noted that composing does not occur in a simple linear progression. Rather, movement forward, whether to continue text production or to edit or plan, occurs in conjunction with movement backwards, to read what one has written and/or to reflect upon one's text.

If composing is a recursive activity, it seems reasonable to expect behavioral manifestations of that recursion, behaviors like rereading one's text. And in fact, researchers have singled out particular writing behaviors which seem to imply recursive activity. Stallard (1974) noted that the "good" student writers in his study stopped to reread their texts more frequently than did the "average" student writers. Similarly, Pianko (1979) found that her "traditional" college writers re-scanned three times more often than her remedial group and concluded that the reflective activity implied by such re-scanning is the parameter which separates good and poor writers. Thus, rereading or re-scanning (a term usually synonymous with rereading all or part of one's text) has been viewed both as evidence of the recursive nature of the writing process, and as a characteristic behavior of "good" writers.

Apart from this correlational evidence that good writers re-scan more, there have been three attempts to test the importance of re-scanning. Britton

(1975) described how he and his research team informally tried writing with worn-out ball point pens on top of carbon paper in order to prevent themselves from reading what they had written. He reported that they were completely thwarted in their attempts to write poetry or to theorize, although they found writing narratives somewhat easier. Britton's experiment was not a formal study, but it did call attention to a potentially useful technology for investigating re-scanning.

Gould (1980), using a similar technology of wooden stylus and carbon paper, tested the importance of being able to re-scan when composing business letters. He found no differences in quality, amount of time spent composing, or the number of proofreading changes between this "invisible" writing and either dictating or "normal" composing. His findings, however, may be limited by the genre he chose. The possibility that the business letter represents a common discourse schema which most writers would have already internalized may explain why there were no significant differences between invisible writing and normal composing. Gould's writing tasks simply did not require the kind of recursive activity which may characterize more complex types of composing like writing an essay, the task used by Perl, Sommers, Pianko, Stallard, and Flower and Hayes . There is also the possibility that writing with a wooden stylus creates a readable imprint; if so, subjects may have had recourse to re-scanning after all. Thus, it is not possible to determine whether Gould's empirical evidence actually tests any of the conclusions about re-scanning drawn by the other researchers in their case studies.

There has been one attempt to investigate the role of recursion in children's writing. Teleman (1981) had 12- to 13-year-old Swedish schoolchildren listen to a short fable and then re-tell it in writing, one group using

visible ink and the other, invisible. He found it impossible to distinguish one text from another, although texts and sentences were slightly shorter in invisible ink. As Teleman points out, these results must be interpreted in light of the fact that the children were provided both content and organization of text. This condition would of course decrease reliance on prior text and thereby fail to provide a test of the recursive activity which might occur in a more complex writing task.

It may be helpful at this point to place the writing behavior of re-scanning and the notion of recursion in the context of a comprehensive learning theory--cybernetics, or negative feedback theory. Wiener (1948) originally defined cybernetics as "the entire field of control and communication theory, whether in the machine or in the animal" (p. 19). He coined the term from a Greek word meaning steersman, a metaphor which offers a simple way to understand the relationship between cybernetics and composing. In order to steer a ship (or to write), one must make continuous judgments. The helmsman of a vessel, for example, keeps on course and off rocks by continually noting any deviation from his course, deciding what (if any) adjustment he needs to make, turning the tiller, observing the effect, and then repeating this process all over again. To "control" his ship, then, the helmsman needs "communication" about his progress; he needs to know how approximate his actions have been. Thus, negative feedback--communication of any change or error--allows the helmsman to right his course and thereby to avoid making the same mistakes indefinitely (see Trask, 1971).

Like other behaviors which involve cognition and information processing, composing is controlled by information, feedback, from prior behavior which serves to influence future behavior. This feedback model of the writing process (Hull, 1981) posits movement toward a desired end product through

a continual interchange of writing and examining and evaluating what has been written against internal standards. As Smith (1966) has shown for a wide variety of complex behaviors, interrupting feedback will cause systematic interference with completion of product or activity. Handwriting performance, for example, deteriorates as a result of inverted and/or reversed visual feedback. There is also a considerable body of scholarship showing that interrupting feedback in speech impedes production (Yates, 1963). Thus, based on the general notion of recursiveness in writing and the research on feedback, it might be expected that situations which interrupt feedback loops would interfere with composing, and also that writers who are more dependent on negative feedback information, what Sommers and others have called dissonance, would show greater disruption than writers who relied less on recursion. It might further be expected, using the conclusions drawn by Stallard and Pianko, that better (or more experienced) writers would depend more upon feedback than poorer (or less experienced) writers. Indeed, it is commonly asserted that poorer writers compose in a linear fashion, which suggests that they don't take advantage of information available through recourse to feedback loops.

Consequently, the purpose of this research was to determine how interrupting feedback--by taking away visual access to what has been written--affected the writing of experienced, good writers and inexperienced, poorer writers. We wanted to determine the effects of interrupting feedback on both the sentence level and on overall quality.

2. Subjects

Eighteen subjects participated in this study (two of the original twenty did not complete all of the writing tasks). Nine of the subjects were inexperienced, poorer writers who were enrolled in basic writing courses. (Basic Writing is a required remedial course for students who score below

a specified level on a holistic writing sample but are not judged to be extremely deficient in writing skills. Thus, the students are not equivalent to Shaughnessy's (1977) basic writers.) The nine experienced, good writers were graduate teaching assistants.

3. Procedure

The design of the study required two essays from each subject in each group, the first written under normal conditions, and the second written under the experimental condition of not being able to see what had been written. The first essay, then, provided baseline data for comparison with the second. For each of the two writing tasks, the basic writers wrote at the same time in a large conference room; the graduate students wrote on a different day. We allowed subjects fifty minutes for their responses to the assigned topics, because students normally have fifty minutes to write in-class essays. There was approximately a one-week interval between the tasks.

So that there would be as little difference between the two writings as we could arrange, for both tasks we supplied the students with fountain pens and with lined paper which had been numbered on every other line. We instructed them, under both conditions, to write only on the numbered lines and only with the pens we had given them. For the first essay, the fountain pens were filled with standard blue ink. For the second, in order to prevent students from seeing what they had written, we filled the pens with invisible ink, a clear, colorless ink which appears only after the paper has been held close to a heat source, e.g., a candle or the burner of a stove. Before the invisible ink task, we explained to the subjects that they would not be able to see what they had written, and we instructed them to use the numbered lines to help them keep their place on the page; if they did lose their place, they were to move down several lines or to

continue on the next page.

4. Topics

The topics used in this experiment were designed to elicit persuasive essays. Research by San Jose (1972), Perron (1976), and Crowhurst (1980) has indicated that this mode elicits the most syntactically complex writing, and thus, we hypothesized, should require more feedback from what has been written. Concomitantly, taking away the ability to refer to one's text might alter that complexity. Furthermore, the persuasive mode requires the conceptualization and sequencing of ideas, but neither the ideas nor the sequence is pre-organized, as is often the case with either the narrative or descriptive mode. Finally, the persuasive mode, more than others, ought to require either extensive planning or extensive rereading since the ideas one presents must lead to a conclusion based on those ideas. Or, in the case of an essay which moves from generalization to supporting evidence (the pattern implied by the topics below), the persuasive mode requires a writer to refer back to the generalization and the previously written text in order to maintain logic and coherence. Thus, if visual feedback has an important role in composing, taking away recourse to read what has been written should clearly affect essays written in the persuasive mode.

Since we could not use the same topic for both tasks (students would remember too much from the first essay when they wrote the second one only a week later), we chose current events topics, assuming that the subjects would have knowledge of both. For the essay written under normal conditions, subjects were given the following topic:

> For some time now there has been a controversy over whether the United States should compete in the 1980 Summer Olympics to be held in Moscow. Some people feel that because Russia has invaded Afghanistan, American athletes should boycott the games. Others, though, feel that politics should not enter the Olympics and that American athletes should be allowed to participate.
>
> Write an essay in which you take a stand on the controversy and argue your position.

For the essay to be written in invisible ink, the subjects were given this topic:

> Recently the issue of draft registration for women has received a great deal of attention. Some people feel that women should have to serve in the armed forces, while others believe they should be exempt from service.
>
> Write an essay in which you take a stand on this issue and argue your position.

5. Sentence Level Analyses

Syntax and Fluency. We analyzed each essay using the standard, global syntactic complexity measures, words per T-unit and words per clause. We selected these metrics because the existing research indicates that better writing in the persuasive mode typically has greater T-unit and clause lengths (and thus, inferentially, better writers write longer T-units and clauses), and also because both measures have been shown to distinguish groups of writers who are several grades apart. We assumed, of course, that freshmen labelled "basic writers" would be considerably distinct from graduate students. Fluency was measured by total number of words produced.

Clause Placement, Type, and Frequency. Assuming that feedback interruption would have the greatest impact on the embedding of less-than-clausal elements, we hypothesized that subjects might use more right-branching full clauses when denied access to visual feedback. Therefore, we analyzed the types and placement of clauses and the frequencies of each placement and type. These clauses were classified as adverbials, relatives, or factives (including That-S, Fact that, and That-S WH). Adverbials were further categorized according to position within the sentence: initial, preceding the subject; final, following the verb; or medial, following the subject but preceding the verb. We classified relative clauses according to two post-nominal positions, pre-verb and post-verb. Factives were sub-divided according to "functional" position: use as the subject or object, i.e., pre-verb or post-verb.

Error Analysis. We developed a taxonomy of all potential sentence level errors that we imagined writers might make. This taxonomy was based on type of error rather than cause of error, the kind of taxonomy proposed by Shaughnessy (1977), because it seems impossible in many cases to determine reliably why a writer makes an error--whether the mistake is a slip of the pen or whether it indicates lack of knowledge about writing conventions. Also, the experimental condition of composing without being able to see what has been written would further confound efforts to identify causation. Indeed, we intended to utilize change in error type or frequency as one broad index of the effect of disrupting feedback, for one function of re-scanning might be to correct slips of the pen.

Our error taxonomy included several general categories: spelling, punctuation, syntax (these categories, of course, were further sub-divided into particular types), omissions/additions, and word order mistakes. We also had categories for errors in verb and pronoun usage, and mistakes in what we called "concatenation" rules, failure to follow a lexical pattern established earlier in a sentence.

In order to control for the amount of writing each subject produced, we calculated errors per various denominators. Since spelling errors occur on the lexical level, we calculated them per number of words written. Because punctuation and pronoun mistakes, syntactic garbles, and incidences of omitted/added words occur on the sentence level, we calculated these errors per T-unit. Because verb errors and mistakes in concatenation occur on the clausal level, we calculated these per clause.

6. Overall Quality Analysis

The best available technique for determining overall quality is the holistic rating, for it does not isolate certain elements such as conformity

to editing conventions, but rather, views the whole as more than the sum of the parts (Cooper, 1977). For our holistic scoring, four raters read all 36 essays from the experiment. These raters previously had received training in holistic scoring and were accustomed to judging multiple student papers. The fact that the raters were pre-trained controlled for any inadvertent bias which may have been built in by the researchers (See Feeedman, in press).

All 36 essays were typed, and the authors' names were removed. Thus, raters had no knowledge of who wrote the papers or under what conditions. Raters were given copies of the essay assignments along with instructions to score the essays holistically. All essays were rated together. We used a forced choice method of scoring (the raters divided the 36 papers into four stacks of nine papers each according to quality) to increase the possibility of distinguishing within group and between tasks. Had all essays been rated without forced choice, we suspected that both essays written by the graduate students might receive the highest rating; thus, it would have been hypothetically possible to have the 18 graduate student papers rated "4" and the 18 basic writer papers rated "1." Our forced choice method avoided this problem.

7. Statistical Analysis

Because we used a small, available sample rather than a randomly selected sample, and because the total number of measured items produced by each group was small, we used non-parametric statistical techniques in our analyses, specifically chi square for quality and sign tests elsewhere. In all cases, we used .05 as the criterion level for significant differences. However, means and standard deviations or standard errors are also presented.

We compared tasks for each group, rather than between groups, for we expected basic writers to differ from graduate students. Our comparison, however, did allow us to examine the groups' commonalities and/or differences across tasks.

8. Results

Fluency. The results of the fluency analysis showed a decrease in total number of words written for both basic writers and graduate students when feedback was disrupted. Certain students decreased enough on the invisible ink writing task in order to have made the overall decrease in words significant had analyses of variance been used. However, this decrease actually involved only about half of the subjects. Roughly half as many students increased total number of words when writing in invisible ink. Thus, we infer that disrupting visual feedback did not significantly influence fluency. Graduate students, however, did write more words under both conditions, as expected, than did basic writers.

Syntax. The global syntactic analyses indicated a significant difference between essays written under normal conditions and those written when feedback was disrupted in number of words per clause: a significant number of both basic writers and graduate students decreased words per clause when feedback was disrupted. Words per T-unit was not changed significantly in either group. Means and standard errors are presented in Figure 1. These data confirm the results of the sign test of individual performance.

Insert Figure 1 about here

Clause Placement, Type, and Frequency. Our analyses of types, placement, and frequency of clauses showed no significant differences between the two writing tasks for either group. Seventy-five percent of all clauses used by graduate students were post-verb for the tasks under normal conditions,

as were 76 percent when feedback was disrupted. For basic writers, 72 percent of all clauses were post-verb on the normal task, and 73 percent when feedback was disrupted.

Insert Table 1 about here

Error. Our analyses of error per various denominators showed that neither graduate students nor basic writers altered their error rate or error type when feedback was disrupted. We also calculated the ratios of total errors per word and total errors per T-unit. There was no significant difference between the tasks for either group on errors per word; in both groups about half decreased their errors per word when feedback was disrupted. However, there were significant differences in both groups' errors per T-unit; in both groups 78 percent of the subjects decreased the number of errors per T-unit when feedback was disrupted. Means and standard deviations for the error categories are presented in Table 2. Some categories have been merged because either no errors occurred in a category or the number of subjects who made the error was too small (often, just one) to be illuminating.

Insert Table 2 about here

Quality. The results of the holistic scoring showed consistent patterns of decrease in quality from normal conditions to disruptive feedback for both groups ($X^2 = 4.00$, $p < .05$)Under normal conditions, graduate students, as expected, wrote papers judged better than those by basic writers, as were their papers when feedback was disrupted. However, the sign test analysis indicated that the holistic ratings for only the basic writers significantly decreased when feedback was disrupted: 7 of 9 decreased, 1 increased, 1 did not change. Among the graduate students, 4 decreased, 1 increased, and 4 did not change. The means and standard errors for the quality ratings

are presented in Figure 2. This figure not only shows the difference between the groups, but more importantly, shows the parallel decline between tasks for both groups. This seems to indicate that inhibiting visual feedback affects both groups similarly.

Insert Figure 2 about here

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9. Discussion

When subjects wrote under the condition of interrupted feedback, they produced essays which differed from those they produced under normal conditions. However, those differences were not as marked or as numerous as might be expected on the sentence level, for either graduate students or basic writers. Students experienced no apparent difficulty in producing well-formed, relatively error-free sentences when they could or could not see what they had written. Here our results are similar to those of Gould, who noted no differences between regular and invisible composition of business letters, and of Teleman, who couldn't distinguish children's texts written in visible ink from those written in invisible ink.

This sentence level constancy suggests that both inexperienced writers and experienced writers have internalized a written style--an habitual syntax perhaps--which they can produce automatically in a timed writing situation, in response to the given topic. The fact that writers can produce such a style when feedback is interrupted perhaps suggests that part of learning to be a fluent writer is developing a memory for one's own written syntax. (But see also Frawley, 1981, whose research on universal grammar suggests that the syntax of unsophisticated writers conforms to "natural" syntactic tendencies which apply across languages, particularly as evidenced by their habits of relativization and sentential complementation.) Krashen's (1981)

hypothesis that second language learners use what he calls "acquired" language (i.e., the language patterns they have formulated inductively) when speaking may be relevant to the non-differences found in this research. The subjects may have recoursed to that acquired language in both tasks. It may be that differences would appear only in revision.

We suggest that the reduction in clause length, the only significant difference in syntax between the two tasks, was a result of memory incapacitation. When denied recourse to what they had written, subjects reacted by decreasing memory load by putting fewer words or perhaps chunks of information into the basic perceptual unit, the clause. We don't mean to suggest here that such a reaction was a conscious strategy; rather, subjects probably resorted to shorter clauses "automatically" as a result of memory strain. (See Daiute, 1981, for her discussion of memory constraints on composing.) Words per clause can, however, decrease without a concomitant decrease in words per T-unit for other reasons besides fewer words being written in each clause. Additional subordinate clauses and new main clauses could produce this effect, as could writing as full clauses what would normally be written as less than clausal structures. Since our second task was not a re-write of the first, we can't say for sure which technique was used.

If memory is the factor, it might be the case that, as writing progresses, the memory load, i.e., recalling prior ideas, might further alter snytax, particularly clause length and placement. During the first part of the essay, the subjects could rely on initial ideas and thus might write longer clauses and place them in other than final position. However, in the last part of the essay, the clauses might decrease in length and tend to occur finally. Therefore, we re-analyzed the essays, examining the first and last thirds. Although there was a consistent pattern in both groups of decreased clause length in the last

third, this occurred in both visible and invisible writing, and the differences were never significant. Furthermore, there were no differences in clause placement. Therefore, it would seem that, for some unknown reason, beginnings and endings are handled differently, syntactically, but there was no increase in memory load. These results seem to indicate that the memory factor is a constant; it exists across text production.

Whatever the explanation for the reduced clause length, this reduction cannot be used to account for the lower holistic rating of the essays written when feedback was interrupted, for as Faigley (1980) has shown, words per T-unit and words per clause account for only three percent of the total variance in holistic evaluations. On the other hand, the fact that sentence level error per T-unit decreased for both groups when feedback was interrupted may suggest that during the second task subjects were attending more to micro-level concerns. If this were the case, then we can account for the lower holistic ratings of the essays written when feedback was disrupted by suggesting that students lost control of their writing beyond the sentence and beyond the paragraph. Our results here are close to those of Britton, although our subjects were certainly not totally thwarted in their efforts to produce a text as were Britton and his research team. Nonetheless, it is important to note that the significance of visual feedback seems to lie, not in editing or manipulating syntax, but in managing larger units of discourse.

This inference receives support from recent research by Flower and Hayes (in press), who have suggested that pauses before "episodes" in think-aloud protocols denote goal-related activities--activities which go beyond sentence level planning. Flower and Hayes don't, however, dismiss the role of sentence level planning in the writing process. Rather, they prefer to think of planning as involving more than one level. We find an interesting parallel to their notion of planning levels in Hurtig's (1977) functional language model. Hurtig makes a distinction between the role of memory on the sentence

level and on the level of discourse in speech production and perception. He summarizes this model as follows:

> the sentence (clause) is the on-line perceptual unit while the discourse (idea set/logical event space) is the unit of cognitive (semantic) memory. Put in other terms, the discourse is the cognitive organizational unit while the sentence (syntactic structure) is the production planning unit.(pp. 103-4).

Hurtig thus argues that language processing involves different levels, a sentence production level and discourse organization level, each playing a different but interactive part. These two levels appear to parallel Flower and Hayes' distinction between types of planning and our own findings concerning the effect of visual feedback on the sentence and on overall quality.

It seems that, by having writers compose in invisible ink, we disrupted the feedback loop which governs composing, but disrupted it only partially; or in Hurtig's and Flower and Hayes' words, we interfered only with one level of processing. While subjects were able to produce well-formed sentences when not allowed to re-scan, they nevertheless were hindered at the level of discourse production. The fact that the disruption was only "partial" reminds us of how complex the composing feedback system is and how interrelated its components must be. (Emig, 1978, makes a similar point when she discusses the "organic" structures involved in composing: eye, brain, and hand.) In isolating one component like re-scanning, we ought not, then, to forget that other components complement its function. Indeed, there may be sufficient redundancy among the components that inhibiting one does not inhibit the whole. While re-scanning allows a writer to compose recursively, other activities, perhaps unobservable or observable but ambiguous ones, contribute to recursion as well. The fact that our writers were able to produce well-formed sentences when visual feedback was disrupted should not be taken even as evidence that sentence production isn't recursive, or, to

use Flower and Hayes' terminology, that "linguistic planning" isn't as important a part of composing. Rather, this phenomenon suggests to us that other components of the writing feedback loop which allow composing to be a recursive activity, components like syntactic memory, aid in sentence production. Thus, while our research indicates that a product written under the disrupted condition is different from a product written under normal conditions, the failure to find consistent differences on all levels suggests that writers, at least writers at the college level, may have sufficient resources to surmount the disruption at the sentence level.

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FIGURE 1
MEAN WORDS PER T-UNIT AND WORDS PER CLAUSE FOR EACH GROUP ON EACH TASK
(WITH STANDARD ERROR)

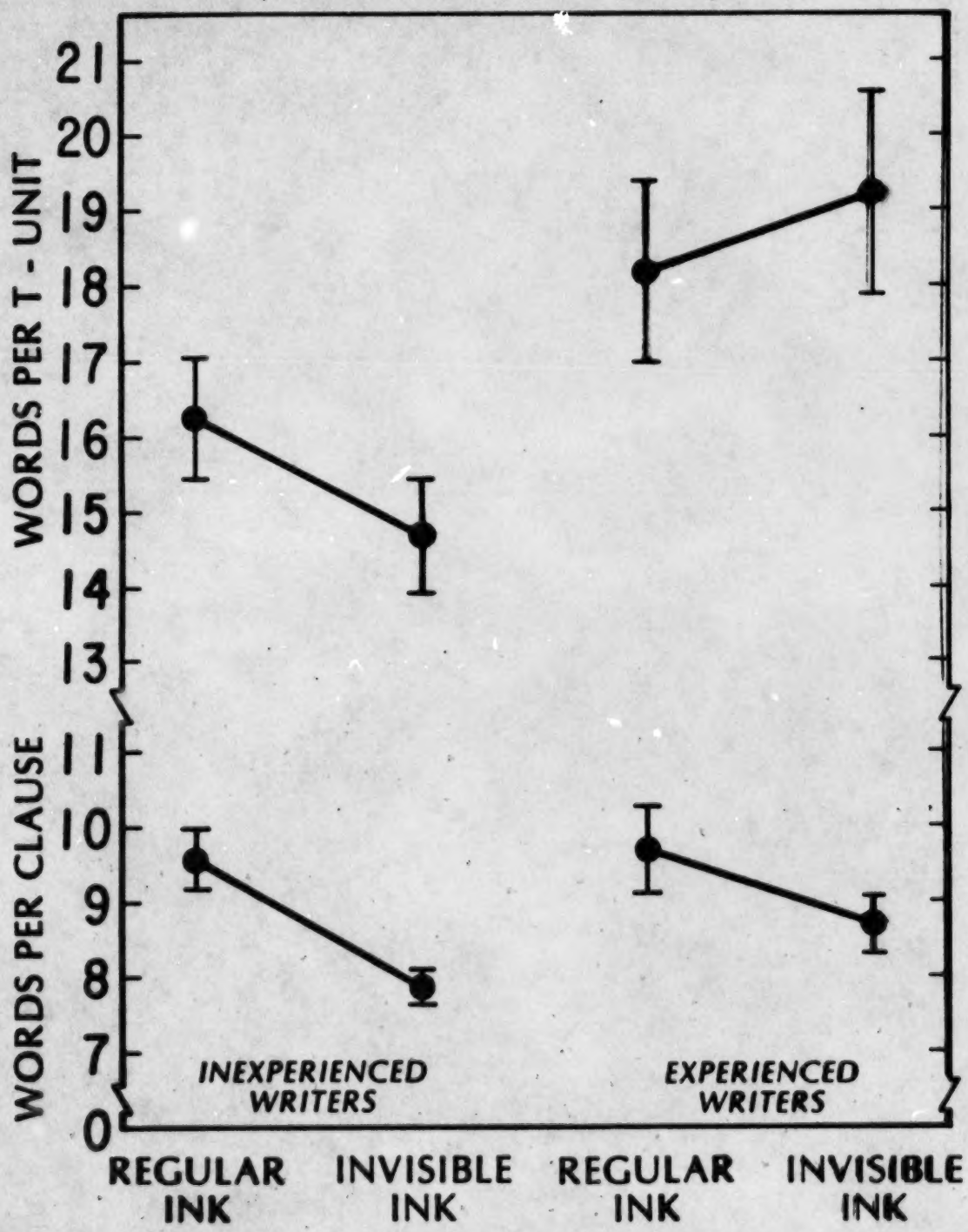

FIGURE 2
MEAN QUALITY RATING FOR EACH GROUP ON EACH TASK
(WITH STANDARD ERROR)

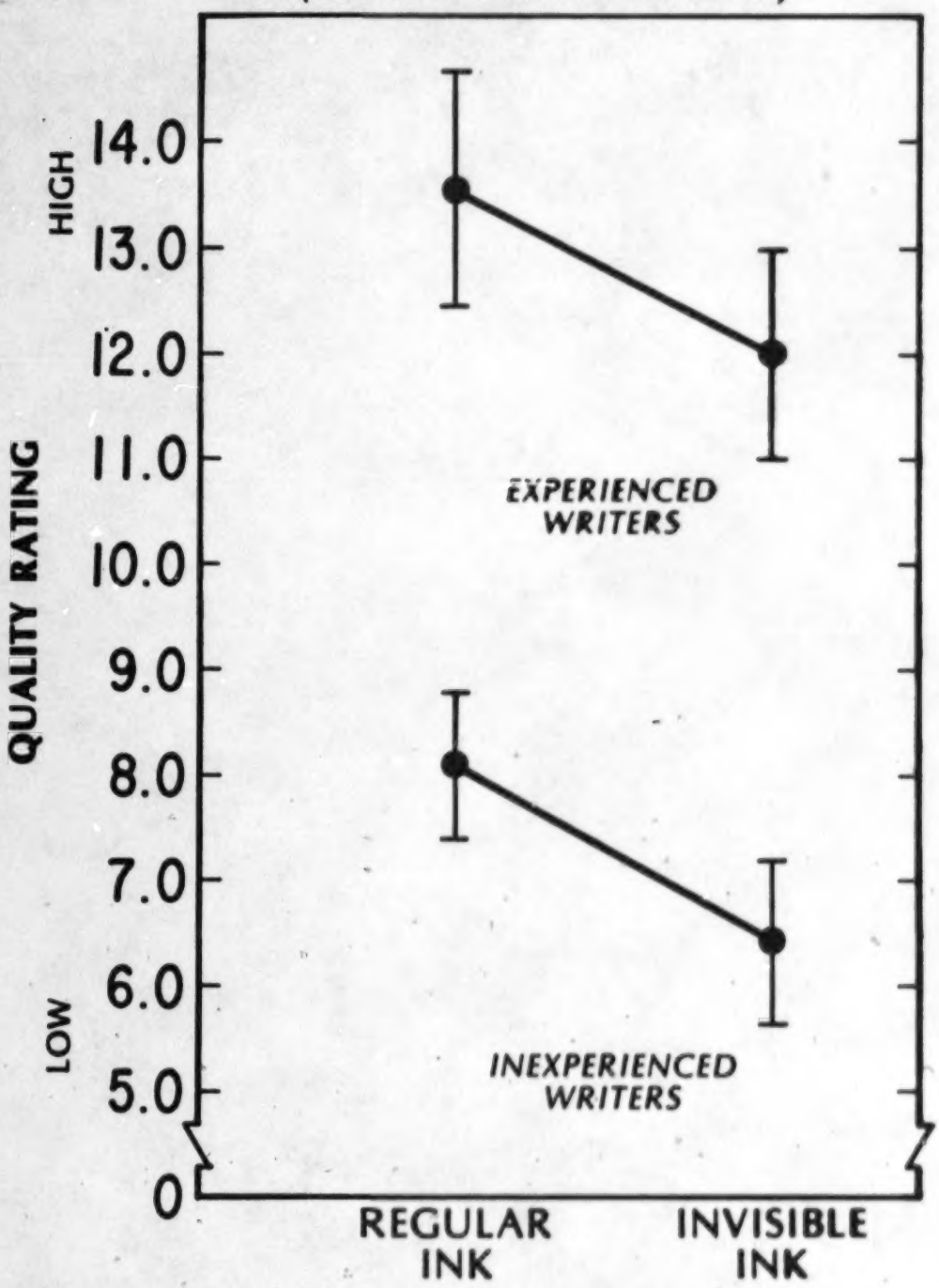

TABLE 1
MEAN FREQUENCY OF CLAUSE TYPE AND PLACEMENT FOR EACH GROUP ON EACH TASK

CLAUSE TYPE:	ADJECTIVE		ADVERB		FACTIVE		ALL CLAUSES	
PLACEMENT:	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL
GROUP:								
INEXPERIENCED WRITERS								
REGULAR INK	.78	1.89	2.11	1.44	.11	4.67	3.11	8.00
INVISIBLE INK	1.00	2.00	2.33	1.78	0.0	5.67	3.56	9.44
EXPERIENCED WRITERS								
REGULAR INK	1.67	4.22	4.78	4.11	.44	12.67	7.00	21.00
INVISIBLE INK	1.22	2.78	4.11	5.00	.44	10.89	5.78	18.67

TABLE 2
MEAN ERROR PROPORTIONS FOR EACH GROUP ON EACH TASK

	SPELLING PER WORD		PUNCTUATION PER T-UNIT		VERB PLUS CONCATENATION PER CLAUSE		OTHERS PER T-UNIT		ALL ERROR PER WORD		ALL ERROR PER T-UNIT	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
GROUP:												
INEXPERIENCED WRITERS												
REGULAR INK	.024	.024	.350	.315	.077	.077	.187	.154	.065	.042	1.113	.806
INVISIBLE INK	.020	.014	.389	.212	.004	.031	.170	.118	.060	.030	.874	.417
EXPERIENCED WRITERS												
REGULAR INK	.007	.006	.142	.059	.013	.011	.046	.039	.020	.007	.339	.113
INVISIBLE INK	.004	.003	.141	.132	.011	.014	.105	.101	.017	.007	.331	.163

NOTE: THE "OTHERS" CATEGORY IS COMPOSED OF ERRORS IN PRONOUN, SYNTAX, WORD ORDER, AND OMITTED/ADDED WORDS